REMARKS

The specification has been amended to correct an editorial error. It can be seen that this example corresponds to the invention disclosed in Section (1) of the specification, which begins on page 16, line 15. Additionally, the specification does not disclose a steel F as an invention. Therefore, the amendment does not introduce new matter.

Claims 1, 3, and 5-11 were pending in the application. In the Office Action dated November 10, 2008, claims 6 to 8 are withdrawn from consideration as directed to a non-elected species, and claims 1, 3, 5 and 9-11 are rejected. In the instant Amendment, claims 3 and 5-8 have been canceled, without prejudice, claims 1 and 9 have been amended, and new claims 16-18 have been added. Upon entry of the instant Amendment, claims 1, 9-11 and 16-18 will be pending in the application.

Claim 1 has been amended to incorporate the limitations of claims 3 and 5. Claim 1 has also been amended to delete the recitation of the composite precipitates of MgO, MgS and (Nb, Ti)N, which is recited in new claim 16.

Claim 9 has been amended to be independent, incorporating the limitations of claims 1 and 3, and to delete the recitation of the composite precipitates of MgO, MgS and (Nb, Ti)N, which is recited in new claim 17.

New claim 18 has been added to recite a ferrite and bainite steel sheet that has a hole-expandability λ (%) at least $-0.134 \times \text{TS}$ (N/mm^2) + 222, *i.e.*, satisfying the following equation $\lambda\ (\%) \geq -0.134 \times \text{TS}\ (\text{N/mm}^2) + 222$. Support for claim 17 is found in the specification at p. 39, l. 33 through p. 40, l. 5, Tables 13-14, and Fig. 8. The equation represents a least square fit of the experimental data presented in Tables 13-14 and Fig. 8 (see, Appendix A). Therefore, claim 18 encompasses steel sheet having a hole-expandability λ above the least square line fit.

No new matter has been added by these amendments. Entry of the foregoing amendments and consideration of the following remarks are respectfully requested.

Applicants' Interview Summary

Applicants wish to thank Examiner Jie Yang for the courtesy extended to Applicants' representatives Messrs. Atsuo Tanaka, Patrick Birde, and Weining Wang for the interview

conducted on June 30, 2009. Ms. Kazuko Sherman was also present at the interview as the translator for Mr. Tanaka. During the interview, the present invention and the cited references Japanese Application No. 2001-342543 ("JP'543"), U.S. Patent No. 6,224,689 ("US'689") and Japanese Patent Publication No. 2002-020838 ("JP'838") were discussed.

Applicants' representatives explained to the Examiner that factors affecting properties of steel sheets, e.g., strength, hole expandability and ductility, includes contents of added elements, microstructure/phase composition, number and/or size of inclusions, etc. The contents of added elements can be characterized by % range of the elements. The contents of added elements can additionally be characterized by equation constraint on % of different elements, e.g., $[Mg\%] \geq ([O\%]/16 \times 0.8) \times 24$. The microstructure of a steel can include ferrite, bainite, martensite, etc., which may depend on contents of added elements, production and treatment processes, etc. The size and density of inclusions, e.g., precipitates of MgO, MgS and (Nb, Ti)N, etc., also affect the properties of the steel, and may depend on contents of added elements, production and treatment processes, etc. Additionally, in the present invention O is one of the most important added element, and it is controlled to not more than 0.005 %.

Applicants' representatives then explained to the Examiner that the claims under examination are directed to steel sheets of either (i) having a structure primarily bainite (claim 5); or (ii) having a structure primarily ferrite and bainite (claim 9). The claimed steel sheets achieve superior strength and expandability and ductility by, *inter alia*, including the added elements in amounts that, in addition to the recited % range, satisfy Equations (1)-(3) and (5)-(7) for species (i), and Equations (1)-(3) and (8) for species (ii). Each of the equations further restricts the contents of respective elements within the recited % ranges.

In contrast, JP'543 teaches steel sheets having a structure primarily ferrite and the reminder bainite (see, Translation of JP'543, p. 36, first paragraph, and pp. 43-45, ¶¶ [0006]-[0010]). JP'838 also teaches steel sheets having a structure mainly ferrite with reminder bainite (see, Translation of JP'838, p. 2, first paragraph, and pp. 10-12, ¶¶ [0005]-[0008]). Neither of JP'543 and JP'838 teaches or suggests the additional constraints on the amounts of added elements as defined by the recited equations. Neither of JP'543 and JP'838 teaches or suggests controlling the oxygen level to not more than 0.005 %.

US'689 teaches steels having a microstructure comprising fine-grained lower bainite, fine-grained lath martensite, or mixtures therefore (see, US'689 Abstract). However, US'689 does not disclose the hole expandability of its steels. Thus, even if combined with JP'543 or JP'838, US'689 does not teach or suggest what strength and hole expandability and ductility can be achieved by modifying JP'543 or JP'838 according to US'689.

Applicants' representatives also presented a chart showing hole-expandability λ as a function of tensile strength TS for the inventive steels of Example 3 of the present application (species (ii) ferrite + bainite steels) as well as steels of JP'543 (Tables 2 and 4) and JP'838 (Tables 2 and 4). Applicants' representatives explained that, as the chart shows, hole expandability decreases as tensile strength increases. A comparison of hole expandability is only meaningful for the same tensile strength. The chart shows that hole expandability of the claimed steel sheets is much higher than steels of JP'543 and JP'838 for each tensile strength within the tested range of tensile strength. In fact, not a single data point of JP'543 and JP'838 reaches the line fit of expandability as a function of tensile strength of the present invention.

<u>Rejections under 35 U.S.C. § 103</u>

Claims 1 and 3 are rejected under 35 U.S.C. §103(a) as being unpatentable over Japanese Patent Publication No. 2001-342543 ("JP'543"). Since claim 1 has been amended to incorporate the limitations of claims 3 and 5, and claim 3 has been canceled, the rejection is now moot.

Claim 5 is rejected under 35 U.S.C. §103(a) as being unpatentable over JP'543 in view of U.S. Patent No. 6,224,689 ("US'689") and Japanese Patent Publication No. 2002-020838 ("JP'838"). In the office action, the Examiner indicates that the rejection is based on the same reasons as stated in the office action mailed February 6, 2008. In the February 6, 2008 office action, the Examiner acknowledged that JP'543 does not teach a steel with a structure comprising primarily bainite. However, the Examiner stated that US'689 and JP'838 teach a steel with a structure comprising primarily bainite, and that it would have been obvious to a person skilled in the art to modify JP'543 with the structure and tensile strength as taught by US'689 and JP'838.

Applicants first respectfully submit that the claimed steel sheet achieves superior strength and expandability and ductility by, *inter alia*, controlling the amounts of added

elements according to Equations (1)-(3) and (5)-(7). Each of these equations further restricts the amounts of the respective elements within the recited % ranges. Example 1 of the present application shows experimental results of the claimed bainite steel sheets. From the data it can be seen that steels that do not satisfy one or more of these equations exhibits inferior expandability and ductility (comparative steels a-g; see specification at p. 25, ll. 22-25; Tables 1, 2 and 4). Therefore, these equations are not general formulae, but constraints on amounts of the respective added elements which characterize steels having excellent hole expandability and ductility. The data also show that not all bainite steel sheet have superior strength and expandability and ductility.

Additionally, in the present invention, O is one of the most important added elements, and is controlled to not more than 0.005 % (specification at p. 11, ll. 3-9).

JP'543 teaches steel sheets having a structure of primarily ferrite and the reminder bainite (see, translation of JP'543, p. 36, first paragraph, and pp. 43-45, ¶¶ [0006]-[0010]). JP'543 does not teach or suggest steel sheets having a structure of primarily bainite, nor hole expandability and ductility of bainite steel sheets. JP'543 does not teach or suggest the additional constraints on amounts of the added element as defined by the recited equations. JP'543 does not teach or suggest controlling the oxygen level O to not more than 0.005 %. Therefore, JP'543 does not teach or suggest the claimed bainite steel sheet.

US'689 discloses an ultra-high strength, weldable, essentially boron-free steels with superior toughness used in linepipes where loss of strength of the HAZ, relative to the remainder of the linepipe, is minimized, and to a method for producing steel plate which is precursor for the linepipe. US'689 teaches steels having a microstructure comprising fine-grained lower bainite, fine-grained lath martensite, or mixtures therefore (see, US'689 Abstract). However, US'689 is not concerned with a steel which exhibits excellent hole-expandability and ductility. Nor does US'689 disclose the hole-expandability and/or ductility of its steels.

JP'838 also teaches steel sheets having a structure mainly ferrite with reminder bainite (see, translation of JP'838, p. 2, first paragraph, and pp. 10-12, ¶¶ [0005]-[0008]). JP'838 mentions that a prior art reference discloses a steel sheet having a structure mainly comprised of bainite. However, JP'838 does not disclose the hole-expandability and/or ductility of such steel sheet (see, translation of JP'838, p. 7, ¶ [0002]).

Therefore, the cited references, alone or in combination, do not teach or suggest achieving high hole-expandability and/or ductility in bainite steel sheets.

Additionally, as the data of the present application show, steel sheets having bainite microstructure may have significantly different strength and hole expandability and ductility. For examples, comparative steels a-g disclosed in Example 1 of the present application all exhibits low hole expandability. Thus, even assuming, *arguendo*, that a person skilled in the art would have modified JP'543 or JP'838 to obtain a steel having a bainite structure, he/she would not have expected to achieve the hole-expandability and ductility of the presently claimed steel sheet.

In the office action, the Examiner contends that the presently claimed steel sheets can be achieved by routine optimization of the amounts of the added elements. Applicants respectfully submit that, for the same reasons discussed in detailed below in connection with claims 9-11, the relations of amounts of added elements as defined by the recited equations are not recognized in the cited references as result-effective variables. Therefore, a person skilled in the art would not have arrived at these equations by routine optimization.

Claims 9 to 11 are rejected under 35 U.S.C. §103(a) as being unpatentable over JP'543 in view of Japanese Patent Publication No. 2002-020838 ("JP'838").

Applicants first respectfully submit that, similar to the claimed bainite steel sheet discussed above, the claimed ferrite + bainite steel sheet achieves superior strength and expandability and ductility by, *inter alia*, controlling the amounts of added elements, in the cases of ferrite + bainite steels, according to Equations (1)-(3) and (8). Each of these equations further restricts the contents of the respective elements within the recited % ranges. Example 3 of the present application shows experimental results of ferrite + bainite steel sheets. From the data it can be seen that steels that do not satisfy one or more of these equations exhibited inferior expandability and ductility (comparative steels a-g; see specification at p. 39, ll. 12-15; Tables 13-14; and Figs. 7-8). Therefore, these equations are not general formulae, but constraints on amounts of respective added elements which characterize steels having excellent hole expandability and ductility. The data also show that not all ferrite + bainite steel sheet have superior strength and expandability and ductility.

Additionally, in the present invention, O is one of the most important added element, and it is controlled to not more than 0.005 %.

Neither of JP'543 and JP'838 teaches or suggest the additional constraints on amounts of the added elements as defined by the recited equations. Neither of JP'543 and JP'838 teaches or suggests controlling the oxygen level O to not more than 0.005 %.

Appendix A present a chart showing hole-expandability λ as a function of tensile strength TS for the inventive steels of Example 3 of the present application as well as steels of JP'543 (Tables 2 and 4, data set A1) and JP'838 (Tables 2 and 4, data set A2). The chart shows that hole expandability decreases as tensile strength increases. A comparison of hole expandability is only meaningful for the same tensile strength. When comparing hole expandability for steels having the same tensile strength, hole expandability of the claimed steel sheets are much higher for all tensile strengths in the tested range. In fact, not a single data point of JP'543 and JP'838 reaches the line fit of hole expandability as a function of tensile strength of the present invention.

In the office action, the Examiner contends that the presently claimed steel sheets can be achieved by routine optimization of the amounts of the added elements. Applicants respectfully submit that "[a] particular parameter must first be recognized as a result-effective variable, *i.e.*, a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation." MPEP at p. 2100-152 (rev. 6, Sept. 2007). In the present case, each of the recited equations defines a relation of the amounts of two or more added elements, which must be satisfied to achieve the high hole expandability and ductility. For example, equation (1) $[Mg\%]\geq([O\%]/16\times0.8)\times24$ requires that the amount of Mg be no less than a quantity determined based on the amount of O. In order to find such an equation, a person skilled in the art would have to first recognize a correlation between the amounts of Mg and O affects hole expandability and ductility, and then optimize the relation between the amounts of Mg and O to obtain the equation. None of the cited references recognizes that a correlation between the amounts of Mg and O affects hole expandability and ductility. None of the cited references teaches or suggests controlling the amount of O in its steels. Therefore, the relation as defined in equation (1) is not recognized as a result-effective variable. The same applies to each of the rest recited equations. A person skilled in the art would not have arrived at these equations by routine optimization.

It is therefore submitted that amended independent claims 1 and 9, and all claims dependent thereon, are not obvious over Japan No. 2001-342543, Japan No. 2002-020838 and/or U.S. Patent No. 6,224,689, alone or in combination.

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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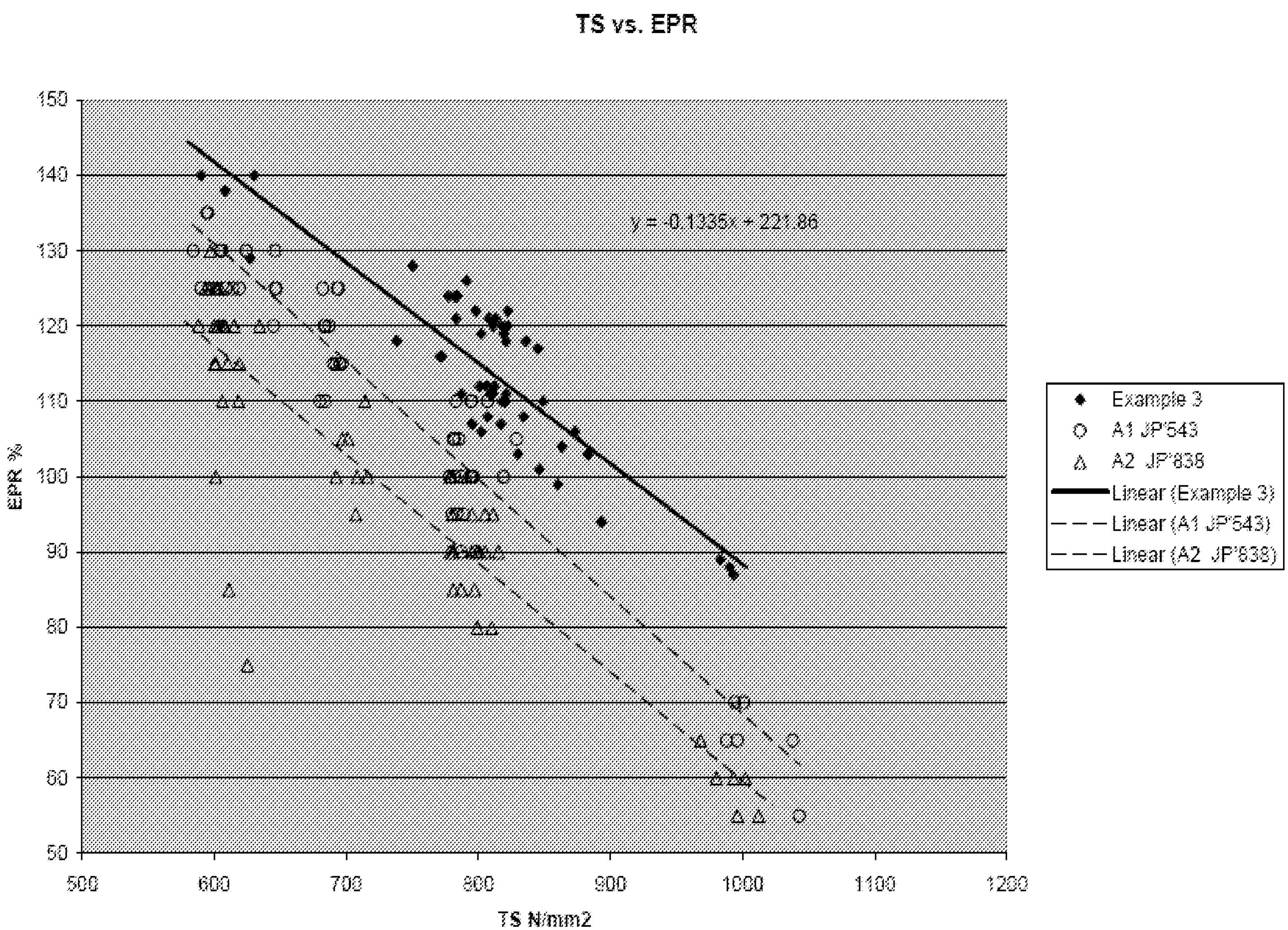
Enclosure: Appendix A

Appendix A



TS vs. EPR
y = -0.1335x + 221.86
EPR %
150
140
130
120
110
100
90
80
70
60
50
500
600
700
800
900
1000
1100
1200
TS N/mm2
Example 3
A1 JP'543
A2 JP'838
Linear (Example 3)
Linear (A1 JP'543)
Linear (A2 JP'838)